REMARKS

This amendment is responsive to the Office Action of January 7, 2009. Reconsideration and allowance of **claims 1-6 and 13-22** are requested.

The Office Action

Claims 11-21 were rejected under 35 U.S.C. § 101.

Claims 1-3, 5-9, 11-13, and 15-21 were rejected under 35 U.S.C. § 102(b) as being anticipated by Malassiotis et al. (Tracking the Left Ventricular in Echocardiographic Images by Learning Heart Dynamics, IEEE Transactions on Medical Imaging, Vol. 18, No 3, 3/1999, pp. 282-290).

Claims 4 and 14 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Malassiotis et al. in view of Qian (U.S. Patent No. 5,381,791).

Background

The present application is directed to an apparatus and method for segmenting a series of 2D or 3D images obtained by monitoring a patient's organ or other body part. A series of transformations is calculated which describe difference between images in a series of images where each transformation is calculated with a fitting operation between two images of the series of images. A first segmentation is carried out on a first image of the series of images. The first segmentation of the first image of the series of images is modified with the transform which relates the first image with a subsequent image and applied to the subsequent image in this manner, the tedious segmentation process is only done once to segment the whole series of images.

Segmenting often involves drawing a line along the boundary between organs, regions, etc. Some images have well defined borders which facilitate segmentation. Even so, segmentation often involves an iterative process of automatic steps and manual adjustments. Performing this segmentation process to all images of a series can be time consuming and computationally intensive.

Moreover, some images have less well defined boundaries and are hard to segment accurately. For example, an image of the heart collated in a longer temporal window in a slow moving potion of the cardiac cycle may have more data

hence better boundaries than an image generate from a shorter temporal window during a fast moving portion of the cardiac cycle. Similarly different imaging modalities define boundaries with different degrees of clarity.

Transformations can be generated e.g. a motion model, based on the whole image that shows the relationship between images. Because more data points are involved, machine calculations of the transformations can be relatively accurate.

The above description of the present application is presented to the Examiner as background information to assist the Examiner in understanding the application. The above description is not used to limit the claims in any way.

The References of Record

In **Malassiotis et al.** each image of the series is segmented. A temporal learning filtering procedure to redefines and tracks the left ventrical detected by an active contour model. A Hough transformation is used to find an initial approximation of the boundary at a first frame. An active contour model is then used for an estimation of the boundary. A PCA transform is applied to constrain the motion of the active contours that are then used to recalculate (segment) the boundary of left ventrical in subsequent slides. The information is incrementally gather directly from the images and used to achieve further frame segmentations.

Qian discloses an a method and apparatus for automatic identification of anatomical features where a nuclear medicine image is scanned and pixels of maximum and minimum intensity are identified and correlated with each other using constraints which are empirically determined to relate to the feature of interest. The information obtained is used to define a region of interest in which an anatomical feature of interest may be located, and to position a scintillation camera detector to carry out a nuclear medicine study at optimal positions.

35 U.S.C. § 101

Claims 11-21 have been amended to address the non-statutory subject matter issue.

The Claims Distinguish Patentably
Over the References of Record

Claims 1-3, 5-9, 11-13, and 15-21 are not anticipated by Malassiotis et al. The rejections are hereby traversed.

More specifically, regarding **claim 1**, Malassiotis et al. does not disclose a transform calculator which calculates a series of transformations, wherein each separate transformation comprises an operation for defining a best fit between two images of said first series of images. Nor does Malassiotis et al. disclose an image converter which transforms the segmentation with the first transformation and applies the transformed segmentation to a subsequent image.

The Office Action refers Applicant to pages 282-287 and Fig. 5 of Malassiotis et al. which discloses a learning filtering procedure for defining the boundary of a left ventricle detected by an active contour model. More specifically, Malassiotis discloses applying a Hough transform to find an initial estimation of an object boundary by approximating its shape as an ellipse at a first frame of a sequence of frames. After the estimation of the object boundary is detected, a number of points are placed uniformly along the estimated ellipses which are used by the active contour model for further refinement of the boundary. Although accurate when motion is small, active contour models are very sensitive to noise and the accuracy of edge detection is reduced when the movement of the boundary is large. Malassiotis et al. solves this problem by using principal component analysis in order to constrain the motion of the active contour. The above procedure reduces the sensitivity to noise and increases accuracy by constraining the motion of the boundary and only allowing the active contour to deform along specific directions. This segmentation procedure is then used to segment subsequent frames to reduce the motion of the active contour and provide more coherent boundary identification. In regards to Fig. 5, a Hough transform is used to provide an estimation of the boundary in frame 5a. The estimation is then used along with principal component analysis in 5b in order to constrain the number of directions the active contour deforms along. The active contour then detects and tracks the object borders in frame 5b. This constraining process is then used in the subsequent frames in order to increase the effectiveness of the convergence of the active contour model applied in subsequent frames 5c-5f. The

information is then gathered through the active countour model applied in the subsequent frames 5b-5f to detect the object boundary.

Malassiotis does not disclose calculating a series of transformations where each separate transformation comprises the best fit between two images of a series of images. Additionally, Malassiotis does not disclose performing segmentation on one image of the series of images and adapting that one segmentation to the other images. By contrast, Malassiotis et al. segments every image of a series of images using the same active contouring technique which iteratively converges on an object. In the present application, the first image (Image A) is segmented with any auto or manual segmenting technique, but a second image (Image B) is not. To segment Image B, the Image A segmentation is transformed with the transform that describes the relationship between Images A and B and the transformed segmentation is applied to, e.g., superimposed on, Image B.

Accordingly it is submitted that independent **claim 1** and **claims 2-6** that depend therefrom distinguish patentable over the references of record.

Claim 17 calls for applying a transform to a first segmented image to generate a second segmented image. Malassiotis et al., by contrast relates to an automated iterative segmentation procedure that is used to iteratively segment each image of a series.

Accordingly it is submitted that independent **claim 17** and **claims 18-21** that depend therefrom distinguish patentable over the references of record.

Claim 22 calls for applying a transformation to a segmented image to transform the segmentation of the first image into a second image. Malassiotis et al. does not disclose a first segmentation on a first image of a series of images that is modified and subsequently applied to a further image of a series of images according to a transformation to apply the segmentation to the further image.

Accordingly it is submitted that independent **claim 22** and **claims 13-16** that depend therefrom distinguish patentable over the references of record.

CONCLUSION

For the reasons set forth above, it is submitted that all claims are not anticipated by and distinguish patentably and unobviously over the references of record. An early allowance of all claims is requested.

Respectfully submitted,

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